

CLAIMS

1. A semiconductor device including a cooling system for controlling temperature of a refrigerant through a heating section and a radiator, said semiconductor device being connected to and cooled by said cooling system,

wherein a variation width ( $\Delta T_1$ ) of temperature controlled by said cooling system through said heating section and said radiator is larger than a temperature variation ( $\Delta T_2$ ) of the refrigerant caused by variations in operating conditions of said semiconductor device ( $\Delta T_1 > \Delta T_2$ ).

2. The semiconductor device according to Claim 1, further comprising suppression means provided to cover an outer periphery of said semiconductor device and suppressing transmission of heat from an ambient atmosphere to said semiconductor device.

3. The semiconductor device according to Claim 2, wherein said suppression means is a channel formed along all surfaces of a housing covering the outer periphery of said semiconductor device and circulating the refrigerant therethrough.

4. The semiconductor device according to Claim 2, wherein said channel for cooling is provided inside said semiconductor device, and

electronic components constituting said semiconductor device are mounted on both sides of said channel.

5. The semiconductor device according to Claim 2, wherein said suppression means is a heat insulating portion provided to cover the outer periphery of said semiconductor device and made of a material having a small thermal conductivity.

6. The semiconductor device according to Claim 2, wherein said suppression means is a heat storage portion provided to cover the outer periphery of said semiconductor device.

7. The semiconductor device according to Claim 2, wherein said suppression means comprises a channel formed along at least two of outer peripheral surfaces of said semiconductor device and circulating the refrigerant therethrough; and

a heat insulating portion provided to cover the other outer peripheral surfaces of said semiconductor device and made of a material having a small thermal conductivity.

8. The semiconductor device according to Claim 1, wherein the refrigerant is water or a mixture prepared by mixing, to water, at least one of alcohols, including ethylene glycol, propylene glycol and butylene glycol, and is used within the range of not lower than 70°C to lower than 100°C.

9. A semiconductor device including a cooling system for controlling temperature of a refrigerant through a heating

section and a radiator,

wherein said semiconductor device is connected to said cooling system and generates heat in amount smaller than the amount of heat generated by said heating section.

10. A vehicular cooling system installed in a vehicle comprising an internal combustion engine and a motor, said motor being controlled by a power conversion unit, said vehicular cooling system comprising:

a cooling unit for cooling a refrigerant; and  
a circulator for circulating the refrigerant cooled by said cooling unit,

said cooling system operating such that the refrigerant cooled by said cooling unit is circulated by said circulator to cool said power conversion unit by the circulated refrigerant, said internal combustion engine or both said internal combustion engine and said motor are cooled by the refrigerant which has been used to cool said power conversion unit, and the refrigerant having been used to cool said internal combustion engine or both said internal combustion engine and said motor is cooled by said cooling unit,

said cooling system being constituted such that a variation width ( $\Delta T_1$ ) of refrigerant temperature controlled through said internal combustion engine and said cooling unit is larger than a temperature variation ( $\Delta T_2$ ) of the refrigerant depending on variations in operating conditions of said power conversion unit ( $\Delta T_1 > \Delta T_2$ ).

11. A vehicular power conversion unit mounted in a vehicle comprising an internal combustion engine and a motor, said vehicular power conversion unit converting power supplied from a battery and controlling driving of said motor,

said vehicular power conversion unit being disposed, upstream of the internal combustion engine, in and cooled by a cooling system which cools said internal combustion engine by a refrigerant cooled by a cooling unit,

wherein said vehicular power conversion unit comprises:  
a casing;

a cooling channel through which the refrigerant supplied from said cooling system flows;

a power conversion circuit module made up of a plurality of semiconductor chips and converting the power supplied from said battery; and

a conversion circuit control board made up of a plurality of electronic components and controlling driving of said semiconductor chips,

said casing containing said power conversion circuit module and said conversion circuit control board,

said vehicular power conversion unit being able to suppress heat transmission from the exterior such that a temperature variation width ( $\Delta T_2$ ) of the refrigerant depending on variations in operating conditions of at least said power conversion circuit module is smaller than a variation width ( $\Delta T_1$ ) of temperature of the refrigerant

controlled through said internal combustion engine and said cooling unit ( $\Delta T_2 < \Delta T_1$ ).

12. The vehicular power conversion unit according to Claim 11, wherein said cooling channel is formed in said casing, and a heat insulating layer is formed in said casing by the refrigerant flowing through said cooling channel, thereby suppressing heat transmission from the exterior.

13. The vehicular power conversion unit according to Claim 11, wherein heat transmission from the exterior is suppressed by forming said casing of a material having a small thermal conductivity.